

5.1 Practice BIn Exercises 1–3, find the indicated real n th root(s) of a .

1. $n = 3, a = 343$

2. $n = 6, a = -64$

3. $n = 5, a = -243$

In Exercises 4–9, evaluate the expression without using a calculator.

4. $36^{3/2}$

5. $16^{3/4}$

6. $(-32)^{2/5}$

7. $(-125)^{5/3}$

8. $256^{-5/4}$

9. $27^{-4/3}$

In Exercises 10–15, evaluate the expression using a calculator. Round your answer to two decimal places when appropriate.

10. $28^{-1/5}$

11. $150^{2/5}$

12. $40,351^{6/7}$

13. $750^{-2/5}$

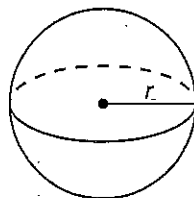
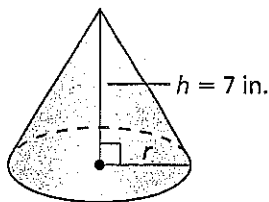
14. $(\sqrt[5]{223})^3$

15. $(\sqrt[7]{-34})^5$

In Exercises 16 and 17, find the radius of the figure with the given volume.

16. $V = 425 \text{ in}^3$

17. $V = 1458 \text{ m}^3$



In Exercises 18–23, find the real solution(s) of the equation. Round your answer to two decimal places when appropriate.

18. $6x^4 = 60$

19. $x^5 = -233$

20. $x^4 + 19 = 100$

21. $x^3 + 17 = 57$

22. $\frac{1}{5}x^4 = 125$

23. $\frac{1}{7}x^3 = -49$

24. Kepler's third law states that the relationship between the mean distance d (in astronomical units) of a planet from the Sun and the time t (in years) it takes the planet to orbit the Sun can be given by $d^3 = t^2$.

- It takes Venus 0.616 year to orbit the Sun. Find the mean distance of Venus from the Sun (in astronomical units).
- The mean distance of Jupiter from the Sun is 5.24 astronomical units. How many years does it take Jupiter to orbit the Sun?

5.2 Practice B

In Exercises 1–6, use the properties of rational exponents to simplify the expression.

1. $\frac{2^{2/5}}{2}$

2. $\left(\frac{3^6}{12^6}\right)^{-1/6}$

3. $\left(11^{3/2} \cdot 11^{-5/2}\right)^{-1/3}$

4. $(9^{-3/5} \cdot 9^{1/5})^{-1}$

5. $\frac{3^{3/4} \cdot 27^{3/4}}{9^{3/4}}$

6. $\frac{25^{5/9} \cdot 25^{7/9}}{5^{4/3}}$

In Exercises 7–12, use the properties of radicals to simplify the expression.

7. $\sqrt[3]{25} \cdot \sqrt[3]{625}$

8. $\sqrt[5]{6} \cdot \sqrt[5]{81}$

9. $\frac{\sqrt[4]{176}}{\sqrt[4]{11}}$

10. $\frac{\sqrt{7}}{\sqrt{700}}$

11. $\frac{\sqrt[3]{5} \cdot \sqrt[3]{50}}{\sqrt[3]{2}}$

12. $\frac{\sqrt[4]{4} \cdot \sqrt[4]{12}}{\sqrt[8]{3} \cdot \sqrt[8]{3}}$

In Exercises 13–18, write the expression in simplest form.

13. $\frac{\sqrt[3]{4}}{\sqrt[3]{9}}$

14. $\sqrt[3]{\frac{4}{25}}$

15. $\sqrt[4]{\frac{2401}{4}}$

16. $\frac{7}{5 - \sqrt{3}}$

17. $\frac{6}{\sqrt{2} + \sqrt{7}}$

18. $\frac{\sqrt{2}}{\sqrt{15} - \sqrt{3}}$

In Exercises 19–24, simplify the expression.

19. $10(25^{2/3}) - 6(25^{2/3})$

20. $2\sqrt{54} - 11\sqrt{6}$

21. $13\sqrt[3]{3} - \sqrt[3]{375}$

22. $\sqrt[5]{486} + 10\sqrt[5]{2}$

23. $4(48^{1/4}) - 3(3^{1/4})$

24. $(7^{1/3}) + 4(189^{1/3})$

25. The volume of a right circular cylinder is $V = 9\pi r^2$, where r is the radius.

- Use radicals to solve $V = 9\pi r^2$ for r . Simplify, if possible.
- Substitute the expression for r from part (a) into the formula for the surface area of a right cylinder, $S = 18\pi r + \pi r^2$.
- Use the answer to part (b) to find the surface area of a right cylinder when the volume is 108 cubic meters.

5.1 B

① $\sqrt[3]{343} = 7$

② $\sqrt{-64}$ No real roots

③ $\sqrt[5]{-243} = -3$

④ $\frac{\sqrt{36^3}}{6^3} = 216$

$$\begin{array}{r} 36 \\ 6 \\ \hline 216 \end{array}$$

⑤ $\sqrt[4]{16^3}$
 $(2)^3 = 8$

⑥ $\sqrt[5]{-32^2}$
 $(-2)^2 = 4$

⑦ $\sqrt[3]{-125^5}$
 $(-5)^5 = -3125$

$$\begin{array}{r} 625 \\ 5 \\ \hline 3125 \end{array}$$

⑧ $\sqrt[4]{256^{-5}}$
 $(4)^5 = \frac{1}{1024}$

$$\begin{array}{r} 256 \\ 4 \\ \hline 1024 \end{array}$$

$$\begin{array}{r} 16 \\ 16 \\ 96 \\ \hline 1600 \\ 256 \end{array}$$

9 $\sqrt[3]{27^{-4}} =$

$(3)^{-4} = \left(\frac{1}{81}\right)$

10 0.51

11 7.42

12 8869.01

13 0.07

14 25.64

15 -12.41

16 $V = \pi r^2 \frac{h}{3}$

$425 = \pi r^2 \left(\frac{1}{3}\right)$

$57.98 = r^2$

$7.61 = r$

7.61 in

17 $V = \frac{4}{3} \pi r^3$

$1458 = \frac{4}{3} \pi r^3$

$348.07 = r^3$

$7.03 = r$

$r = 7.03 \text{ m}$

$$(18) \quad 6x^4 = 60$$

$$x^4 = 10$$

$$x = \pm 1.78$$

$$(19) \quad x^5 = -233$$

$$x = -2.97$$

$$(20) \quad x^4 + 19 = 100$$

$$x = \pm 3$$

$$(21) \quad x^3 = 40$$

$$x = 3.42$$

$$(22) \quad x^4 = 625$$

$$x = \pm 5$$

$$(23) \quad x^3 = -343$$

$$x = -7$$

$$(24) \quad a. d^3 = t^2$$

$$d^3 = (0.616)^2$$

$$d^3 = 379456$$

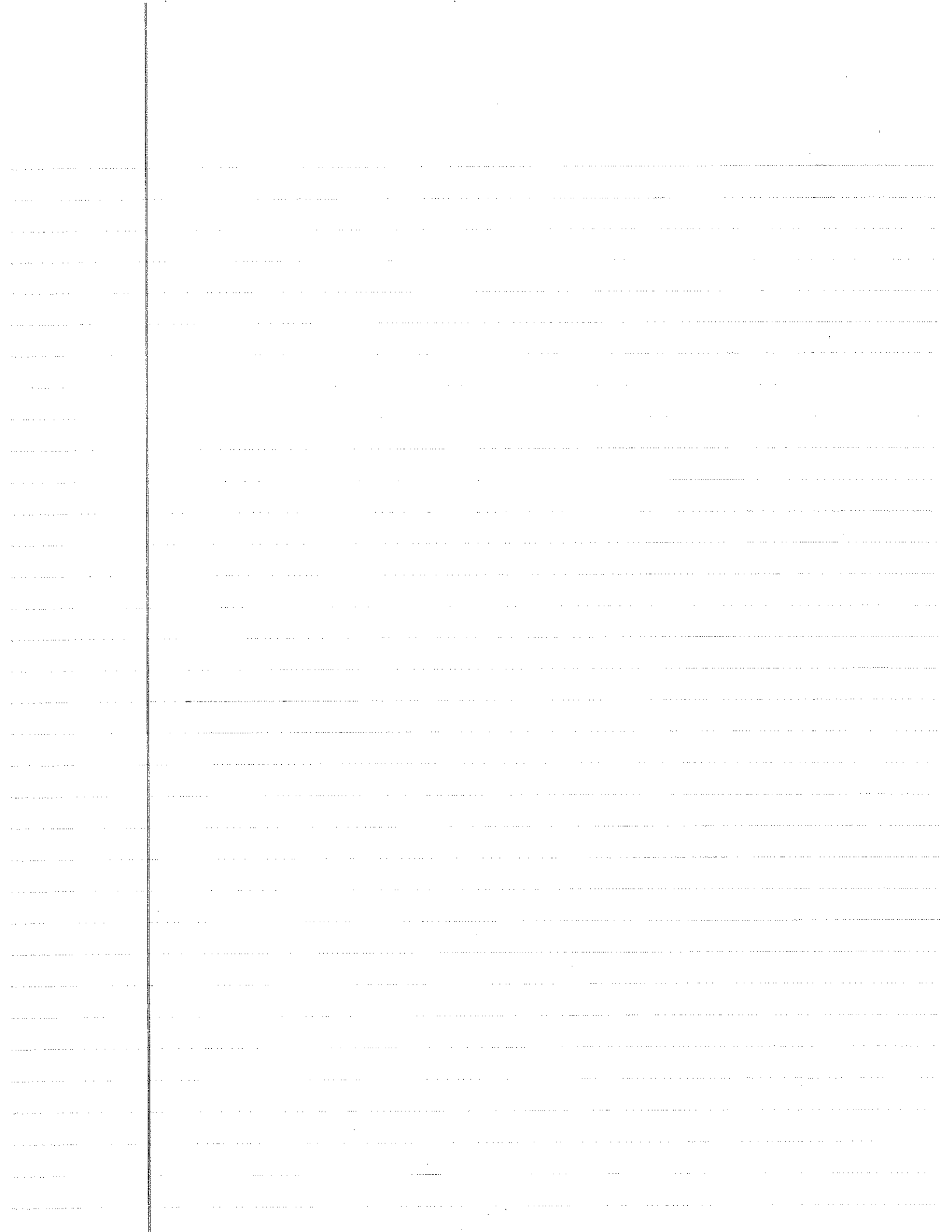
$$d = 0.72 \text{ au}$$

$$b. (5.24)^3 = t^2$$

$$143.88 = t^2$$

$$11.99 = t$$

about 12 years



5.2 B

$$\textcircled{1} \frac{1}{(2)^{3/5}} = \frac{1}{\sqrt[5]{2^3}} = \frac{1}{\sqrt[5]{8} \sqrt[5]{4}} = \boxed{\frac{\sqrt[5]{4}}{2}}$$

$$\textcircled{2} \left(\frac{1}{4}\right)^{6 \cdot \frac{1}{6}} \left(\frac{1}{4}\right)^{-1} = \textcircled{4}$$

$$\textcircled{3} ((11)^{-1})^{-\frac{1}{3}} (11)^{\frac{1}{3}} \quad \textcircled{\sqrt[3]{11}}$$

$$\textcircled{4} (9^{-\frac{2}{3}})^{-1} = 9^{\frac{2}{3}} = \sqrt[3]{9^2} = \cancel{\sqrt[3]{81}} \quad \textcircled{\sqrt[3]{81}}$$

$$\textcircled{5} (9)^{3/4} = \sqrt[4]{9^3} = \sqrt[4]{729} = \textcircled{3\sqrt[4]{9}}$$

$\begin{matrix} 9 \cdot 81 \\ \hat{3} \cdot \hat{3} \cdot \hat{9} \cdot \hat{9} \\ \hat{3} \cdot \hat{3} \cdot \hat{3} \cdot \hat{3} \end{matrix}$

$$\textcircled{6} \frac{25^{4/3}}{5^{4/3}} (5)^{4/3} = \sqrt[3]{5^4} = \textcircled{5\sqrt[3]{5}}$$

$$\textcircled{7} \sqrt[3]{15625} = \textcircled{25}$$

$\begin{matrix} 25 \cdot 625 \\ \hat{5} \cdot \hat{5} \cdot 25 \cdot 25 \\ \hat{5} \cdot \hat{5} \cdot \hat{5} \cdot \hat{5} \cdot \hat{5} \cdot \hat{5} \end{matrix}$

$$\textcircled{8} \quad \sqrt[5]{486} = \textcircled{3\sqrt[5]{2}}$$

\wedge
 $243 \cdot 2$
 \wedge
 $81 \cdot 3 \cdot 2$
 \wedge
 $9 \cdot 9 \cdot 3 \cdot 2$
 $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 2$

$$\textcircled{9} \quad \sqrt[4]{16} = \textcircled{2}$$

$$\textcircled{10} \quad \frac{1}{\sqrt{100}} = \textcircled{\frac{1}{10}}$$

$$\textcircled{11} \quad \sqrt[3]{125} = \textcircled{5}$$

48
 \wedge
 $6 \cdot 8$
 \wedge
 $3 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

$$\textcircled{12} \quad \frac{\sqrt[4]{48}}{\sqrt[8]{9}} = \frac{2\sqrt[4]{3}}{\sqrt[4]{3}} = \textcircled{2}$$

$\sqrt[8]{3^2}$

$$\textcircled{13} \quad \frac{\sqrt[3]{4}}{\sqrt[3]{9}} \cdot \frac{\sqrt[3]{3}}{\sqrt[3]{3}} = \frac{\sqrt[3]{12}}{\sqrt[3]{27}} = \textcircled{\frac{\sqrt[3]{12}}{3}}$$

9604
 \wedge
 $2401 \cdot 4$

$$\textcircled{14} \quad \frac{\sqrt[3]{4}}{\sqrt[3]{25}} \cdot \frac{\sqrt[3]{5}}{\sqrt[3]{5}} = \frac{\sqrt[3]{20}}{\sqrt[3]{125}} = \textcircled{\frac{\sqrt[3]{20}}{5}}$$

\wedge
 $7 \cdot 3 \cdot 4 \cdot 3 \cdot 2 \cdot 2$

$7 \cdot 4 \cdot 9 \cdot 7 \cdot 2 \cdot 2$

$7 \cdot 7 \cdot 7 \cdot 7 \cdot 2 \cdot 2$

$$\textcircled{15} \quad \frac{\sqrt[4]{2401}}{\sqrt[4]{4}} \cdot \frac{\sqrt[4]{4}}{\sqrt[4]{4}} = \frac{\sqrt[4]{9604}}{2}$$

$\sqrt[4]{9604}$
 \wedge
 9604
 \wedge
 $2401 \cdot 4$
 \wedge
 $7 \cdot 3 \cdot 4 \cdot 3 \cdot 2 \cdot 2$
 \wedge
 $7 \cdot 4 \cdot 9 \cdot 7 \cdot 2 \cdot 2$
 \wedge
 $7 \cdot 7 \cdot 7 \cdot 7 \cdot 2 \cdot 2$

$$(16) \frac{7(5+\sqrt{3})}{(5-\sqrt{3})(5+\sqrt{3})} = \frac{35+7\sqrt{3}}{25-3} = \frac{35+7\sqrt{3}}{22}$$

$$(17) \frac{6(\sqrt{2}-\sqrt{7})}{(\sqrt{2}+\sqrt{7})(\sqrt{2}-\sqrt{7})} = \frac{6\sqrt{2}-6\sqrt{7}}{2-7} = \frac{6\sqrt{2}-6\sqrt{7}}{-5}$$

$$(18) \frac{\sqrt{2}(\sqrt{15}+\sqrt{3})}{(\sqrt{15}-\sqrt{3})(\sqrt{15}+\sqrt{3})} = \frac{\sqrt{30}+\sqrt{6}}{15-3} = \frac{\sqrt{30}+\sqrt{6}}{12}$$

$$(19) 4(25^{2/3})$$

$$4\sqrt[3]{25^2}$$

$$20\sqrt[3]{5}$$

$$4\sqrt[3]{625}$$

$$25 \cdot 25$$

$$5 \cdot 5 \cdot 5 \cdot 5$$

$$(20) 2\sqrt{54} - 11\sqrt{6}$$

$$9 \cdot 6$$

$$3 \cdot 3 \cdot 6$$

$$-5\sqrt{6}$$

$$6\sqrt{6} - 11\sqrt{6}$$

$$(21) 13\sqrt[3]{3} - \sqrt[3]{375}$$

$$75 \cdot 5$$

$$25 \cdot 3 \cdot 5$$

$$5 \cdot 5 \cdot 3 \cdot 5$$

$$8\sqrt[3]{3}$$

$$13\sqrt[3]{3} - 5\sqrt[3]{3}$$

(22) $\sqrt[5]{486} + 10\sqrt[5]{2}$
 $\begin{array}{c} \widehat{6 \cdot 81} \\ \widehat{2 \cdot 3} \quad \widehat{4 \cdot 9} \\ 2 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \end{array}$

$13\sqrt[5]{2}$

$3\sqrt[5]{2} + 10\sqrt[5]{2}$

(23) $4(\sqrt[4]{48}) - 3(\sqrt[4]{3})$
 $\begin{array}{c} \widehat{6 \cdot 8} \\ 3 \cdot 2 \cdot 4 \cdot 2 \\ 3 \cdot 2 \cdot 2 \cdot 2 \end{array}$

$5\sqrt[4]{3}$

$8\sqrt[4]{3} - 3\sqrt[4]{3}$

(24) $\sqrt[3]{7} + 4\sqrt[3]{189}$
 $\begin{array}{c} \widehat{27 \cdot 7} \\ 9 \cdot 3 \cdot 7 \\ 3 \cdot 3 \cdot 3 \cdot 7 \end{array}$

$13\sqrt[3]{7}$

$\sqrt[3]{7} + 12\sqrt[3]{7}$

(25) a. $V = 9\pi r^2$
 $r^2 = \frac{V}{9\pi}$

$r = \sqrt{\frac{V}{9\pi}} = \frac{\sqrt{V}}{3\sqrt{\pi}} \sqrt{\pi} = \frac{\sqrt{V\pi}}{3\sqrt{\pi}}$

b. $S = \frac{6}{8\pi} \sqrt{V\pi} + \pi \left(\frac{\sqrt{V\pi}}{3\sqrt{\pi}} \right)^2$

$S = \frac{3}{4} \sqrt{V\pi} + \frac{V}{9}$

C.S.A. = $36\sqrt[3]{108\pi} + \frac{108}{9}$
 $\begin{array}{c} \widehat{9 \cdot 12} \\ 3 \cdot 3 \cdot 3 \cdot 4 \end{array}$

$SA = (36\sqrt{3\pi} + 12)m^2$